EPA United States Environmental Protection Agency

Air and Radiation (6202J)

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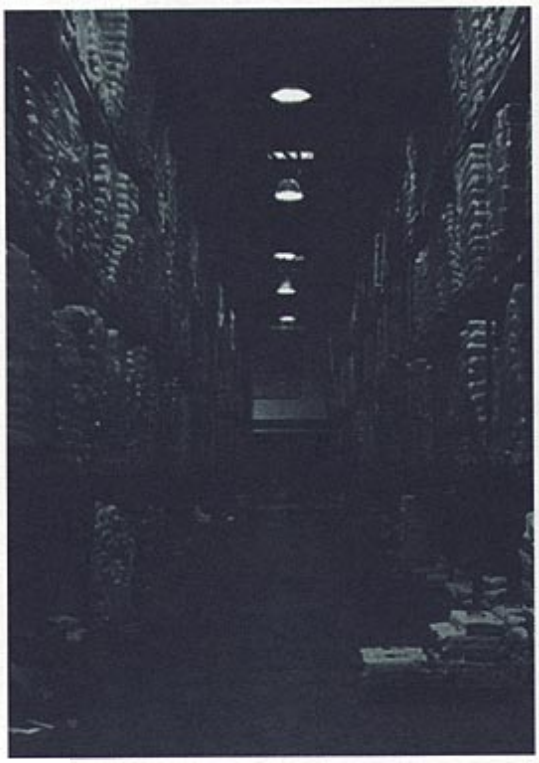
APPLICATION PROFILE

High-Intensity Discharge (HID) Bi-Level Switching

EPA Green Lights
an ENERGY STAR program



Photos courtesy of Wide-Lite

L.L.Bean®

New Reserve Warehouse Building

Freeport, Maine

Energy Manager:
Ron Jacques

Contractor:
Lighting Solutions, Inc.

Utility:
Central Maine Power

PROJECT RESULTS

Energy Savings	70%
Installed Cost	$124,215
Rebate	$43,608
Internal Rate Return	29%
Simple Payback	2.7 years
Annual kWh Savings	311,500 kWh
Pollution Prevented	
CO_2	342,650 lbs/yr
SO_2	2,750 lbs/yr
NO_x	960 lbs/yr

TYPICAL APPLICATIONS

- Warehouses
- Parking Lots
- Loading Docks
- Gymnasiums
- Security Lighting
- Arenas

HID BI-LEVEL SWITCHING

Technology for Controlling HID Systems with Occupancy Sensors

When high-intensity discharge (HID) lighting systems are turned off, they require up to 20 minutes to cool down before they can turn on again. And an additional 2-5 minutes may be needed for the lamps to return to full brightness. Because of this inability to hot restrike, HID lighting systems may operate continuously, up to 12 to 24 hours per day, even if the space is occupied only a fraction of that time.

HID bi-level switching controls can be used to dim down — not turn off — these HID lighting systems to save energy during periods when the space is unoccupied. Therefore, bi-level HID switching systems are used to operate the lamps in a reduced-wattage "standby" condition until the sensors detect occupancy, and the lights are rapidly returned to full brightness.

Bi-level HID switching systems can be installed as a retrofit to existing HID luminaires or as a direct luminaire replacement. Occupancy sensors communicate with the bi-level control located at each luminaire via low-voltage wire, fiberoptic cable, or powerline carrier signals. As a result, specific luminaires may be controlled independently of the power circuit.

Benefits

- Wattage reductions of up to 70% can be achieved while operating in the standby mode; reduced air conditioning costs for removing heat from the lighting system can add to these savings.
- Bi-level systems can serve as a theft-deterrent in parking lot applications; the lights will brighten when people approach the lot.
- Multi-purpose facilities illuminated with HID lighting can be manually controlled with bi-level (or even tri-level) systems to provide a choice of light levels.
- When periods of vacancy coincide with periods of peak demand, bi-level HID switching will contribute to savings in peak electricity demand charges.
- Bi-level switching in warehouses can help warehouse managers track where activity occurs.
- In addition to occupancy sensor and manual controls, bi-level systems can be controlled by inputs from photosensors or scheduling systems.

Issues

- Standby light levels are typically 15-40 percent of full light output; the standby wattage is 30-60 percent of full wattage. (See graph.)
- Although the lights appear to instantaneously return to full output when occupancy is detected, they rapidly return to about 80 percent output and then take up to a minute to reach full output.
- New HID luminaires are available with dedicated occupancy sensors and bi-level switching ballasts so that no control wiring is needed.
- When metal halide lamps operate in the standby light output setting, the color rendering index will decline, and their color temperature will increase (become bluer). Use coated metal halide lamps to minimize these effects.
- Alternative technologies to consider for occupancy sensor control of high-bay lighting systems include instant-restrike high-pressure sodium lamps and high-bay compact fluorescent luminaires.

MANUFACTURERS OF BI-LEVEL HID SWITCHING SYSTEMS

- Thomas Lighting
- Holophane
- Hubbell
- Lithonia
- Ruud Lighting
- Wide-Lite (Genlyte)
- Superior Electric

Call the Green Lights Hotline at 1-888-STAR-YES for addresses and phone numbers of Green Lights Allies.

CASE STUDY

L.L.Bean®

Why use bi-level switching? According to Ron Jaques at L.L. Bean, it makes perfect sense. "It's a reserve warehouse. We use this facility to store seasonal stock. Most of the warehouse is in use only 30 percent of the time, and some aisles won't see people for days."

Ron had already upgraded the lighting to more efficient high pressure sodium lighting and adjusted the light levels. He was seeing the energy savings already. "Because this building was unoccupied for most of the time, it only made sense that controls should be used. High pressure sodium has a long restrike time, so bi-level switching was the obvious solution."

After researching different products and performing metered trial installations, Ron found bi-level switching to be a profitable upgrade that maintained the necessary light levels for efficient operation. He chose a system that uses fiberoptics to communicate between the sensors and the ballasts because "fiberoptics offered huge benefits over hardwiring — especially in the installation costs."

To improve energy savings, Ron chose to control each aisle's lighting in two zones. Each zone (or half aisle) is controlled by two high-mount infrared occupancy sensors, and only those zones that are occupied receive full illumination.

The project results are outlined on the cover.

Facility Information:

- 180,000 square feet
- 44 aisles
- (7) 250-watt high pressure sodium lamps per aisle
- (4) infrared occupancy sensors per aisle
- (2) controlled zones per aisle
- 6,936 hours per year

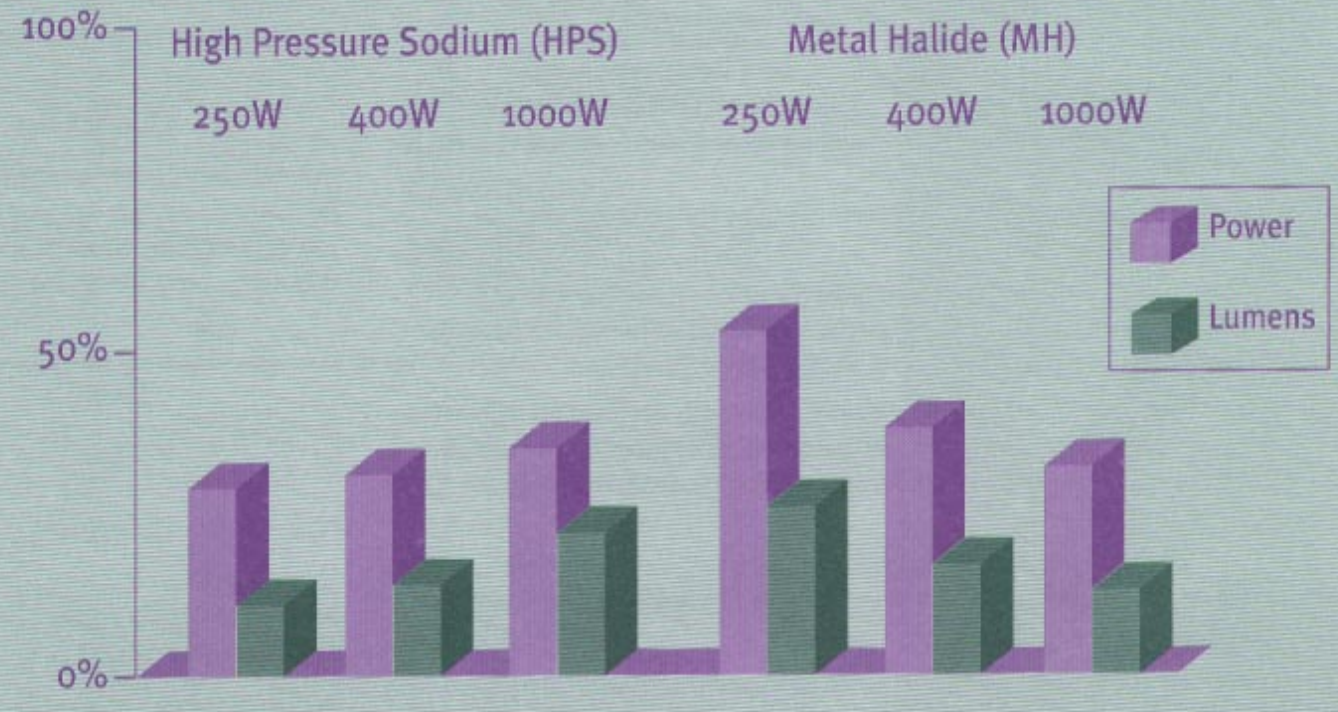
"Once the nuts and bolts are done, then you need to start looking at controls . . . that's where the big savings are."

-Ron Jacques
Energy Manager

Equipment Information:

- HID Fiber Optic Bi-Level Control by Wide-Lite

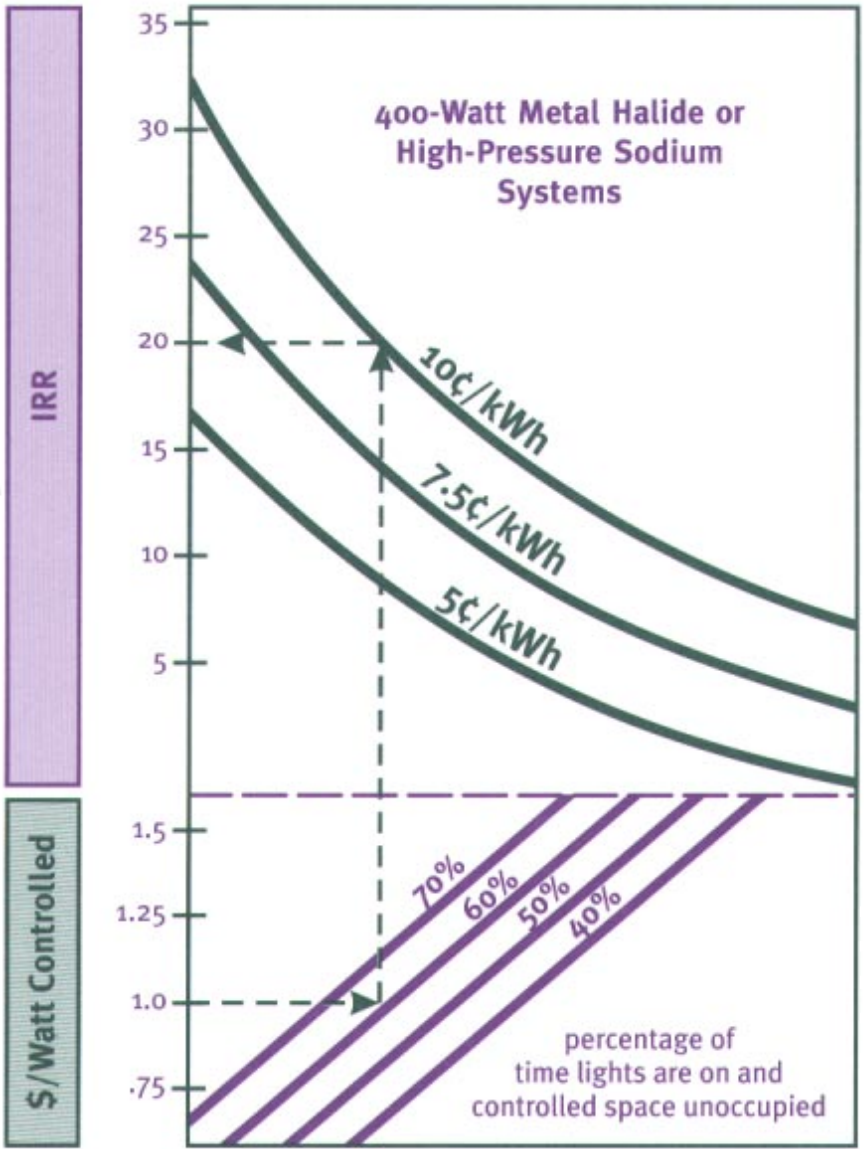
Typical Bi-Level Performance in Reduced Output



* Results will vary by manufacturer

WILL IT WORK FOR YOU?

COST ANALYSIS FOR RETROFIT HID BI-LEVEL SYSTEMS



Use the graph to estimate the cost-effectiveness of an HID bi-level switching system in your facility.

1. Determine your installed cost of the bi-level control system per watt controlled, and mark this point on the graph. *For example, $10,000 installed cost for controlling a 10,000-watt lighting load would be $1.00/watt.*
2. Draw a horizontal line from this point until it intersects the line that represents the percentage of the time your lights are on when the space is unoccupied. *For our example, the space is unoccupied 60 percent of the time when the lights are on.*
3. Draw a vertical line from this point until it intersects the curve that represents your average electricity rate. *In our example, the electricity rate is 10 cents per kilowatt-hour.*
4. Draw a horizontal line from this point until it intersects the vertical axis that measures the after-tax internal rate of return. *Our sample upgrade earns an after-tax internal rate of return of 20 percent.*

The Green Lights Program offers 2-day Lighting Upgrade Workshops, Application Profile brochures, and other technical support services to assist program participants in applying cost-saving lighting strategies. For more information, call the Green Lights Hotline at 1-888-STAR-YES.

Graph Assumptions

- Post-tax analysis: marginal income tax rate of 30 percent. (Tax-exempt entities will earn a higher internal rate of return on their investment than what is determined in the graph.)
- 3 percent inflation for energy and maintenance costs
- 6,000 hours per year of lighting operation. (Fewer lighting operating hours per year may result in reductions in the internal rate of return.)
- No demand savings assumed. Depending on when the lights are dimmed, savings in peak demand charges can be significant. Contact your utility representative.

IRR and cost savings will vary based on system wattage, hours of operation, inflation, corporate tax structure, and utility rate structure.

FOR MORE INFORMATION

"Dimming Systems for High-Intensity Discharge Lamps", Lighting Answers, Vol. 1, No. 4, September 1994.

The Green Lights Lighting Upgrade Manual, Lighting Upgrade Technologies Chapter, 1995.